Rainfall-Runoff Modelling in Arid Areas

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Abstract

Arid areas have distinctive hydrological features substantially different from those of humid areas. The high temporal and spatial distribution of the rainfall, flash floods, absence of base flow, sparsity of plant cover, high transmission losses, high amounts of evaporation and evapotranspiration and the general climatologies are examples of such differences.

The aim of this Ph.D. research is to use advanced tools of model analysis to test some of the current models that consider arid area hydrological characteristics. As most models were mainly developed for other regions, an attempt is made to study their limitations using Omani hydrological data, providing some guidelines for improved rainfall-runoff modelling in arid areas in general and Oman in particular. Two different types of models were selected for this research; KINEROS2, which is an event based, semi-distributed, physically-based model that is considered suitable to be used for arid area conditions, and IHACRES which is a continuous-time, conceptual model, which was applied in both lumped and semi-distributed modes.

These models were applied to hourly and daily data from 25 runoff events during the period 1996-1999 in Wadi Ahin, area 734km^2.

By calibration to each event individually, KINEROS2 could fit a chosen characteristic of the hydrographs well (either volume, peak, or time-to-peak); but in general it could not fit the characteristics together, and there was very high uncertainty in predictions due to the variability of parameter values over events. The lumped IHACRES performed poorly using any selected objective function when fitted over a 2-year calibration period using daily data; and no benefit was noticed using either a more complex version or using the semi-distributed version. However, there was evidence that the semi-distributed IHACRES performs better than any of the other tested models if hourly data is used. The general conclusions are that performance is limited primarily by data constraints and

hence the models cannot be assessed fairly; and semi-distributed models with simple process representations may be preferred.